Spring-21
CSE246(1)
Peer Reviewed Assignment-1
Full Marks-100

Answer all three questions. You have 120 hours to complete your answers. Your solutions may be both handwritten or computer-typed. Once you are done, compile your solutions in a single PDF files containing your answers to all questions respectively. Submit your solutions via google classroom.

Answer allocated one from Part 1
Answer four including Question 3 and Question 6 from Part 2
Answer Part 3

Part 1:

1. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

   8, 2, 3, 1, 4, 5, 6, 7

2. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

   1, 2, 5, 8, 3, 7, 6, 4

3. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

   5, 2, 1, 4, 3, 7, 6, 8

4. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

   2, 1, 5, 3, 4, 7, 8, 6

5. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

   3, 2, 6, 4, 5, 8, 1, 7

6. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

4, 2, 1, 8, 3, 5, 7, 6

7. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

2, 4, 3, 7, 1, 5, 8, 6

8. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

8, 6, 3, 1, 7, 5, 2, 4

9. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

7, 5, 2, 1, 8, 6, 3, 4

10. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

7, 5, 2, 1, 8, 6, 3, 4

11. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

4, 6, 3, 1, 8, 5, 2, 7

12. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

2, 3, 6, 7, 8, 5, 4, 1

13. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

8, 5, 6, 1, 2, 3, 4, 7

14. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

    1, 5, 4, 7, 2, 3, 6, 8

15. Demonstrate how the sorting is done in the following array using quicksort. Show every steps of the work including each swap operation during each call of the partition function.

    2, 3, 4, 8, 1, 5, 6, 7

Part 2:

1. Sumon needs exactly 59 GB of mobile data. His mobile service operator offers various packages like 21 GB of internet for the price of 60 BDT, 34 GB of internet for the price of 150 BDT, 4 GB of internet for 15 BDT, 13 GB of internet for the price of 35 BDT and so on. The same offer can be bought twice, for example the 21 GB mobile net offer can be bought twice, giving him 42 GB of mobile data for 120 BDT. Identify which algorithm can help Sumon determine the minimum cost he needs in order to buy exactly 59 GB of mobile data. Justify your choice of the algorithm.

2. Suppose you need to sort all the content in a computer's hard disk. However, the disk is almost completely full, so you cannot use any extra memory. Between merge sort and selection sort, which sorting algorithm would you prefer to use and why?

3. Programmers from around the world have gathered in a unique “code sprint” festival. In the festival, the participating programmers get a chance to write code for tech giants from around the world, and earn some well-deserved cash in the process. Different companies have declared various offers for the programmers, and the offers are of the type, “code for us for a maximum of X hours, and earn Y takas for each hour you code.” For instance, if a company offers 8000 takas for each hour of programming, and allows you to code for them for a maximum of 5 hours, you may decide to work for them for 4 hours and earn 32,000 takas in the process.

   You are participating in the festival. Naturally, you want to earn as much money as possible. You collect information about the rates offered by all the companies, and the maximum number of hours they will allow you to code. The festival will run for 8 hours, and you cannot code for the companies before the festival starts or after it ends. Describe

which algorithm can help you determine which companies you should code for, and for how many hours you should code for each of them in order to maximize your profit.

4. In the safari, a tiger has many options to choose from when deciding what to have for food. It could try to catch a deer, or a cow, or a boar, or a buffalo, or go for a swim in the nearby river and have some fish. Of course, tigers have large appetites, and want to catch as much food as possible. The tiger has noticed that the other animals in the safari are uniquely punctual and they all have their own timetable. For example, the deers come out at 9 a.m in the morning, the buffalo herd comes out at 11 am, the school of fish comes near the surface of the water at 1pm in the afternoon, etc. The tiger knows that among a large number of animals who travel in a group, the tiger can only catch one animal from that group, since after it catches one animal, the others will run away for their lives. After hunting different animals, the tiger will need to rest for different periods of time before it can go out for another hunt. For example, after catching a deer at 9 am, the tiger will need to rest for 3 hours, and it will become 12 pm in the afternoon before it can go out to hunt again. This naturally means that if he catches a deer, he will miss out on the opportunity to hunt a buffalo. After catching a buffalo, on the other hand, the tiger might need to rest for 2 hours. After catching a fish, the tiger might need to rest for 30 minutes only. This resting period will vary depending on the type of animal that is hunted.

   The tiger has patiently collected all the data regarding when each animal will come out and for how long it will have to rest before being able to go out on a hunt again after hunting that animal. He wants to hunt down as many animals as possible. Describe which algorithm can help the tiger determine which animals it should hunt. The algorithm should be efficient, and should work for all types of schedules and resting periods.

5. A pirate finds several treasure chests on a deserted island. Each chest is made out of a special type of iron, and cannot be broken by the tools that the pirate and his crew members possess currently. The pirate thus plans to take the chests to the nearest port city intact, and break the chests using the more advanced tools available in that city. However, aboard his ship is a special X-ray machine that helps him to ascertain the number of coins available in each of these chests. Using this machine, he determines the profit he will make by taking each chest. However, the chests are quite heavy as well, the pirate is reminded by his crew members that the total weight of the treasure he will carry cannot surpass a certain capacity, or otherwise his ship might sink while crossing the stormy ocean.

   The pirate thus decides on a simple greedy approach to determine which chests he will take. He decides to take chests in the decreasing order of their profit per kilogram up until the total weight of the chests stays within the capacity of the ship. For example, if he

finds 4 chests with weights of 7 kg, 5 kg, 2 kg, and 1 kg respectively and if the number of coins in those boxes are 10, 4, 6 and 2 respectively, and if his ship's capacity is a total of 11 kilograms, the pirate will take the chest weighing 2 kilograms first, and then the chest weighing 1 kilogram and then the chest weighing 7 kilograms, earning him a total of 6+2+10=18 coins.

As his trusted man, you are skeptical about the robustness of the pirate's approach, and you wonder if this approach will work for all sets of inputs. Now, it's time to make up your mind. If you feel the pirate's approach will work for boxes of all weight values and for all possible number of coins in them and for all possible capacity values of the ship, explain why you think so. Otherwise, provide a counterexample containing boxes of different specifications and specify the ship's capacity for the case in which you feel the captain's approach will not work.

6. A prime number is a number that is divisible by only 1 and the number itself. In this problem, we define an "almost prime number" as a number that is divisible by 3 integers- by 1, by the number itself and by another integer. For example, 4 is an almost prime number since it is divisible by 1, 2 and 4 only. Similarly, 9 is an almost prime number since it is divisible by 1, 3 and 9 only. 6 is not an almost prime number since it is divisible by four numbers-1, 2, 3 and 6.

   Design an algorithm that takes an integer n as input and outputs all the almost prime numbers from 1 to n. Your answer will be judged mainly according the efficiency of the algorithm.

Part 3:

1. **Find maximum length Snake sequence**: Given a grid of numbers, find maximum length Snake sequence and print it. If multiple snake sequences exist with the maximum length, print any one of them.
   A snake sequence is made up of adjacent numbers in the grid such that for each number, the number on the right or the number below it is +1 or -1 its value. For example, if you are at location (x, y) in the grid, you can either move right i.e. (x, y+1) if that number is ± 1 or move down i.e. (x+1, y) if that number is ± 1.
   For example,
   9, 6, 5, 2
   8, 7, 6, 5
   7, 3, 1, **6**
   1, 1, 1, **7**

In above grid, the longest snake sequence is: (9, 8, 7, 6, 5, 6, 7)

Part 1 Question Allocation

Student ID	Name	Part1-Question No
2018-2-60-031	Fahmida Nusrat Promy	1
2018-2-60-032	Tasnim Mozumder Anannya	2
2018-2-60-069	Somaiya Akter Sania	3
2018-2-60-104	Ayasha Akter Eava	4
2018-2-60-107	Md. Anam Mofazzal Durjoy	5
2018-2-60-120	Tanveer Ahmed	6
2018-2-60-133	Tasnia Afrin Chowdhury	7
2018-3-60-002	Md. Hasibul Hasan Mehedi	8
2018-3-60-081	Md. Asfakul Islam	9
2018-3-60-082	Md. Siam Ali	10
2019-1-60-014	Oshin Nusrat Rahman	11
2019-1-60-034	Sadia Huq	12
2019-1-60-048	Abu Fahim Khan Shantanu	13
2019-1-60-055	Lamyea Tasneem Maha	14
2019-1-60-060	Noor Fabi Shah Safa	15
2019-1-60-061	Ajmiri Afrin Priniya	1
2019-1-60-066	Mehedi Hassan Adnan	2
2019-1-60-068	Md. Shahadat Anik Sheikh	3
2019-1-60-071	Fahad Bin Kashem	4
2019-1-60-093	Md. Asad Chowdhury Dipu	5
2019-1-60-094	Md. Mizanur Rahman Riad Khan	6
2019-1-60-098	Kazi Mostaq Hridoy	7
2019-1-60-108	A. M. Feroz Ehses Shishir	8
2019-1-60-109	Md. Faisal Ahmed Ridoy	9
2019-1-60-116	Talha Zubaer Siddique Alquraishy	10
2019-1-60-120	Jahani Shabnam Chadni	11
2019-1-60-125	Md. Nazmul Islam Nayeem	12
2019-1-60-134	Rawnak Jahan Taifa	13
2019-1-60-137	Syeda Tasfia Tasnim	14
2019-1-60-140	Md. Ariful Islam	15